DEER VALLEY 4wd MEADOW RESTORATION and BLUE LAKES ROAD MAINTENANCE PROJECT

HYDROLOGY REPORT   July 14, 2015

This report analyzes the impacts to aquatic features that are likely to result from the Deer Valley 4wd Meadow Restoration and Blue Lakes Road Maintenance Project, referred to as the Deer Valley/ Blue Lakes Project in this report. The landscape of the project area is mountainous and partially forested, with elevations ranging between 6,120 and 9,800 feet.

Alternatives 1, 3 and 4 would result in the following effects:

- The segment of the Blue Lakes Road (09N01) west of Twin Lake would be brought into compliance with Standard & Guideline #100 of the 2004 Sierra Nevada Forest Plan Amendment. This would likely improve the condition of the meadows that are crossed or bordered by this road.
- The amount of sediment from OHV use that reaches Deer Creek at Meadow 09N83-2 would be reduced.
- Streambanks on Blue Creek (at Meadow 09N82-1) and Deer Creek (at Meadow 09N82-2) that have damaged by past OHV use would be rehabilitated.

The effects described above for Alternatives 1, 3, and 4 would not occur under Alternative 2 (No Action).

The three watersheds that contain the Deer Valley/Blue Lakes Project are currently at a *low* risk of cumulative watershed effects (CWE). None of the alternatives change the risk of CWE in these three watersheds.

Trail 19E01 crosses Deer Creek.

Steve G. Markman, Hydrologist

AFFECTED ENVIRONMENT

This report analyzes the impacts to meadows that are likely to result from the Deer Valley 4wd Meadow Restoration and Blue Lakes Road Maintenance Project, referred to as the Deer Valley/Blue Lakes Project in this report. The project is located in the Eldorado National Forest in northern California.

The three watersheds that contain the Deer Valley/Blue Lakes Project are located in the headwaters of the Mokelumne River of the Sierra Nevada Mountains. The landscape is mountainous and partially forested, dotted with meadows, lakes, and outcrops of granitic rocks. The elevation ranges between 6,600 and 9,800 feet. As a result of the elevation, most of the precipitation falls as snow between November and April and the hydrology is dominated by snowmelt from May through July.

The Deer Valley 4wd Trail (19E01 or 09N83) occurs in the HUC 7 watersheds of Blue Lakes and Lower Deer Creek, and the Blue Lakes Road (09N01) occurs in the Meadow Creek watershed (Figure 1).

The Deer Valley 4wd Trail (19E01 or 09N83) traverses two large meadows and two perennial streams (Figure 1).

- The trail crosses Blue Creek in Clover Valley at Meadow 09N83-1.
- The trail crosses Deer Creek in Deer Valley at Meadow 09N83-2.

The Blue Lake road (09N01) west of Twin Lake crosses or is bordered by a number of small meadows.

Physical characteristics of the project area are summarized in Table 1. Meadows crossed or bordered by the Deer Valley 4wd Trail (19E01 or 09N83) and the Blue Lakes Road (09N01) are described in detail in Table 2. The rating of these meadows with regard to Standard & Guideline #100 of the Sierra Nevada Forest Plan Amendment of 2004 is also included in Table 2.[1,2] Photographs of roads/trails and aquatic features are in Figures 2 through 12.

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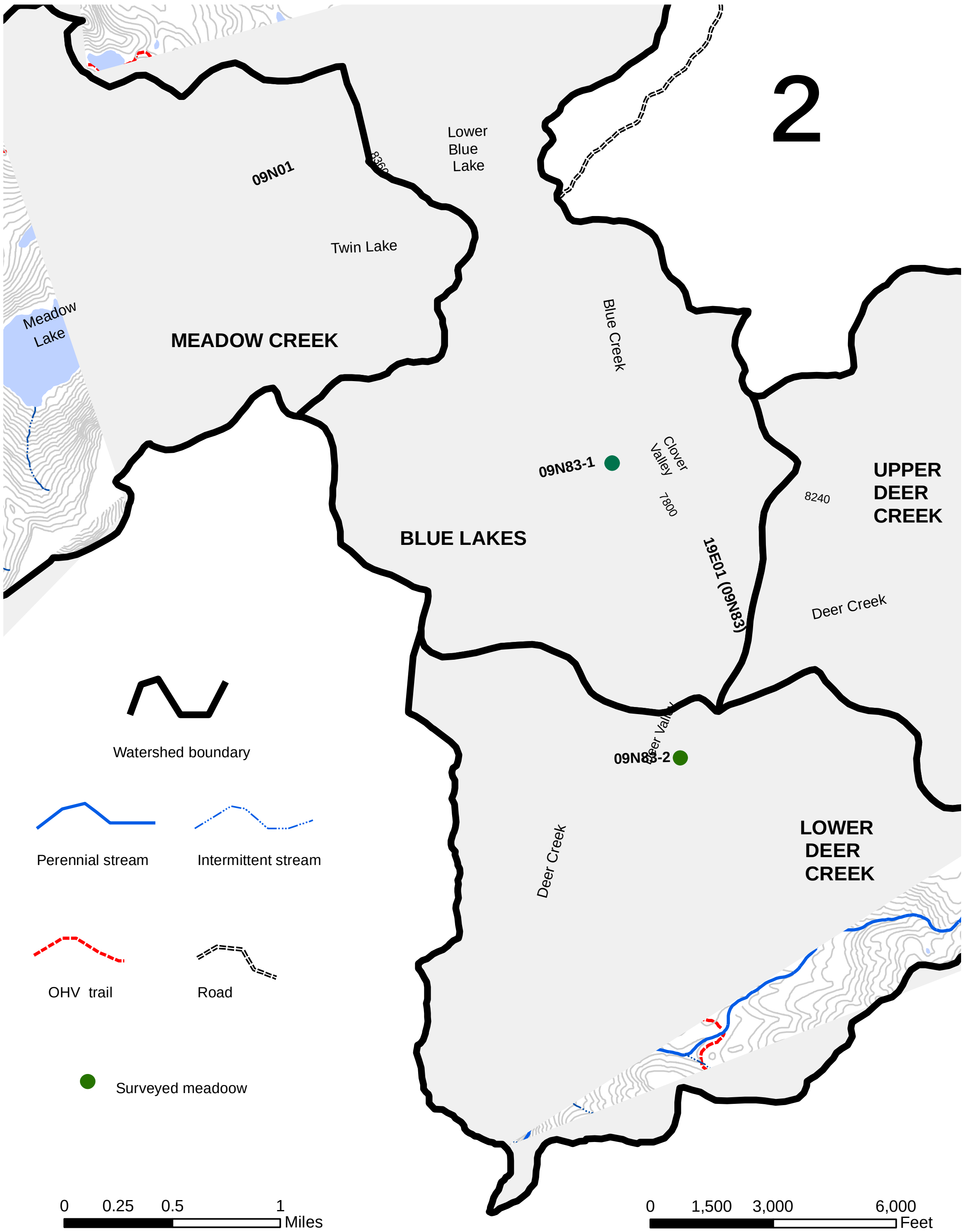
[1] Standard & Guideline #100 states: *"Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity."*

[2] The methodology for evaluating compliance with Standard & Guideline #100 is in Appendix A. This methodology is copied from the Supplemental Environmental Impact Statement, Eldorado National Forest Travel Management (USDA 2013).

Figure 1. Watersheds and aquatic features of the Deer Valley/Blue Lakes Project.



(Note: The Blue Lakes Road (09N01) does not extend to eastern edge of Meadow Lake as shown in Figure 1.)

Table 1. Physical characteristics of the Deer Valley/Blue Lakes Project area.[1,2,3,4]

<table>
<tr><td>Location</td><td colspan="2">▪ Eastern portion of the Eldorado National Forest (ENF) on the south side of highway 88.
▪ South of Lake Tahoe, California.</td></tr>
<tr><td>Drainage basin</td><td colspan="2">The project area is located at the headwaters of the Mokelumne River drainage basin in the Sierra Nevada Mountains. The entire drainage basin is 2,143 square miles in size.</td></tr>
<tr><td>Watersheds</td><td>▪ Meadow Creek. #1521. 4,981 acres
▪ Blue Lakes. #1411. 5,227 acres.
▪ Lower Deer Creek. #1711. 2,955 acres.</td><td>▪ Between 6,600 and 9,800 feet in elevation.
▪ Approximately 34 percent of the area is covered by forest.
▪ Approximately 3 to 8 percent of each watershed is covered by lakes and ponds.
▪ Outcrops of granitic rocks occur in the three watersheds.
▪ The three watersheds comprise 0.96 percent of the Mokelumne River drainage basin.</td></tr>
<tr><td>Climate</td><td colspan="2">Average annual precipitation is approximately 50 inches. Much of the precipitation falls as snow between November and April, although rain in the form of thunderstorms can occur in the summer.</td></tr>
<tr><td>Aquatic features</td><td colspan="2">▪ Blue Creek, a 2.7 mile long perennial stream, flows to the south and into Deer Creek. Blue Creek flows through meadow 09N83-1. Blue Creek at meadow 09N83-1 is subject to high streamflows as illustrated in Figure 13.
▪ Deer Creek, a 4.8 mile long perennial stream, flows south/southwest and into the North Fork Mokelumne River. Deer Creek flows through the meadow 09N83-2. Deer Creek at meadow 09N83-2 is subject to high streamflows as illustrated in Figure 13.
▪ Meadow 09N83-1 at Clover Valley. Trail 19E01 crosses the meadow.
▪ Meadow 09N83-2 at Deer Valley. Trail 19E01 crosses the meadow.
▪ The westernmost 0.8 miles of road 09N01 crosses or is adjacent to a complex of small meadows and their associated Riparian Conservations Areas (RCAs). The road also traverses the RCAs of a number of a number of meadows without crossing or bordering the actual meadow. (The RCA is 300 feet surrounding meadows).
▪ A number of lakes are in the area. The largest named lakes are Lower Blue Lake, Twin Lake, and Meadow Lake.</td></tr>
<tr><td>Hydrology</td><td colspan="2">Dominated by snowmelt from late spring through early to mid-summer (May through July). This means that streamflows are often high during this time period, and then decline in late summer and fall (August through October).</td></tr>
<tr><td>Beneficial uses of water</td><td colspan="2">Municipal water supplies for domestic use; hydropower generation; contact and non-contact recreation; canoeing and rafting; cold freshwater habitat; spawning habitat; and wildlife habitat. There are no bodies of water on the 303(d) list in the three HUC 7 watersheds that contain the project.</td></tr>
<tr><td>Land disturbances</td><td colspan="2">Land disturbances consist mostly of roads, trails, campgrounds, and facilities associated with hydropower generation (i.e. dams, buildings).</td></tr>
</table>

[1] The location of features is shown in Figure 1.
[2] Beneficial uses of water are designated by the Central Valley Regional Water Quality Control Board (CVRWQCB).
[3] Refers to Section 303(d) of the Clean Water Act, which gives states the authority to identify bodies of water that are impaired.
[4] The Riparian Conservation Area (RCA) is 300 feet surrounding meadows, 300 feet on each side of perennial streams, and 150 feet on each side of intermittent and ephemeral streams.

Table 2. Summary of meadows along the Deer Valley 4wd Trail (19E01) and the Blue Lakes Road (09N01).

Meadow	Characteristics	Rating with respect to Standard & Guideline #100 [1,2]
09N83-1	▪ Located in Clover Valley at an elevation of approximately 7,800 feet. ▪ The Deer Valley 4wd Trail (19E01 or 09N83) goes through the meadow and crosses Blue Creek. The width of the trail crossing of Blue Creek is approximately 50 to 70 feet wide at low streamflows and the approaches to the crossing are less than 10 percent slope (Figures 2 & 3). ▪ The crossing of the Deer Valley 4wd Trail (19E01) at Blue Creek is a "raw" crossing. This means that vehicles drive on the bottom of the stream channel in order to cross the stream – there are no structures or other improvements. This has resulted in several impacts: a) the stream channel has grown wider at the crossing, b) damage to riparian vegetation is occurring along the streambanks, and c) a plume of fine-grained sediment travels a short distance downstream when vehicles cross the stream – this causes the turbidity of the stream to be elevated and the deposition of fine-grained sediment downstream.[3] ▪ Photographs of the area are in Figures 2 and 3.	Meadow 09N83-1 was rated as meeting Standard & Guideline (S&G) #100 in July 2011.
09N83-2	▪ Located in Deer Valley at an elevation of approximately 7,440 feet. ▪ Deer Creek, a 4.8 mile long perennial stream that flows south/southwest and into the North Fork Mokelumne River, flows through the meadow 09N83-2. ▪ The Deer Valley 4wd Trail (19E01 or 09N83) goes through the meadow and crosses Deer Creek. The width of the trail crossing of Deer Creek is approximately 30 to 50 feet at low streamflows and the approaches to the crossing are less than 10 percent. ▪ The crossing of the Deer Valley 4wd Trail (19E01) at Deer Creek is a "raw" crossing. This means that vehicles drive on the bottom of the stream channel in order to cross the stream – there are no structures or other improvements. This has resulted in several impacts: a) the stream channel has grown wider at the crossing, and b) damage to riparian vegetation has occurred along the streambanks, and c) a plume of fine-grained sediment travels a short distance downstream when vehicles cross the stream – this causes the turbidity of the stream to be elevated and the deposition of fine-grained sediment downstream.[3] ▪ A 250 ft. long segment of the Deer Valley 4wd Trail (19E01) at Meadow 09N83-2 is less than 30 feet from Deer Creek, and Deer Creek is actively eroding towards the trail. ▪ Photographs of the area are in Figures 4 through 7.	Meadow 09N83-2 was rated as <u>not</u> meeting S&G #100 in July 2011. The meadow was re-evaluated in August 2014 and found to be in compliance with S&G #100 – this re-evaluation is in Appendix A. However, other concerns were noted with regard to the Deer Valley 4wd Trail in Meadow 09N83-2 as described in the column "characteristics" of Table 2.
09N01-ALL	▪ The westernmost 0.8 miles of road 09N01 crosses or is adjacent to a complex of small meadows.[4] The road and the parking area at the end of the road occupy less than 10 percent of the complex of meadows. ▪ Road 09N01 contains large rills at a few locations. Several culverts have one or more of the following: a) the culvert is small in diameter and partially plugged with sediment, b.) erosion of the road is occurring at the culvert outlet, d) erosion is occurring in the channel immediately below the culvert. Water ponds on portions of the road during spring snowmelt. ▪ Photographs of the area are in Figures 8 through 12.	The westernmost 0.8 miles of road 09N01 were rated as <u>not</u> being in compliance with S&G #100 in July 2011 for two reasons: a) sediment from the road was reaching meadows and causing portions of the meadows to dry out, and b) culverts were interfering with the movement of water through meadows.

[1] Standard & Guideline #100 states: *"Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity."*

[2] The methodology for evaluating compliance with Standard & Guideline #100 is described in Appendix A.

[3] The distance that the plume of sediment travels downstream and the actual turbidity values of the stream depend on a number of factors, such as: a) the discharge of the stream, b) the velocity of the water, c) the type and number of vehicles crossing the stream at nearly the same time, d.) the composition and integrity of the stream channel bottom at the time when vehicles drive across the stream, and d) the width of the stream channel when vehicles cross the stream. In September 2014, a visible plume of sediment traveled approximately 100 feet downstream of where trail 19E01 (09N83) crosses Deer Creek at Meadow 09N83-2 after the stream was crossed by several jeeps at approximately the same time – the water appeared clear approximately 100 feet downstream of the crossing as well as upstream of the crossing.

[4] As a result, one field form was used to evaluate road 09N01 and the meadows crossed or bordered by this road.

Figures 2 and 3. Aerial view and ground view of trail 19E01 (09N83) at the crossing of Blue Creek and Meadow 09N83-1 in Clover Valley.

Figures 4 and 5. Aerial view and ground view of the Deer Valley 4wd Trail (19E01) at the crossing of Deer Creek and Meadow 09N83-2 in Deer Valley.

Figure 6. A segment of the Deer Valley 4wd Trail (19E01) at Meadow 09N83-2 is less than 30 feet from Deer Creek. *(Aug. 2014).*

Figure 7. Eroding streambank of Deer Creek at Meadow 09N83-2. *(August 2014).*

Figure 8. The Blue Lakes Road (09N01) crosses or borders a complex of small meadows. Sediment from the road is eroding into a small portion of the meadow in the bottom of this photo – this is described in Point #6 in Table 3. *June 2015.*

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Figure 9. A 400 foot long rill in the Blue Lakes Road (09N01) delivers runoff and sediment off of the road and into a small meadow – this is described in Point #2 in Table 3. Only a portion of the rill and meadow are shown in this photo. *June 2015.*

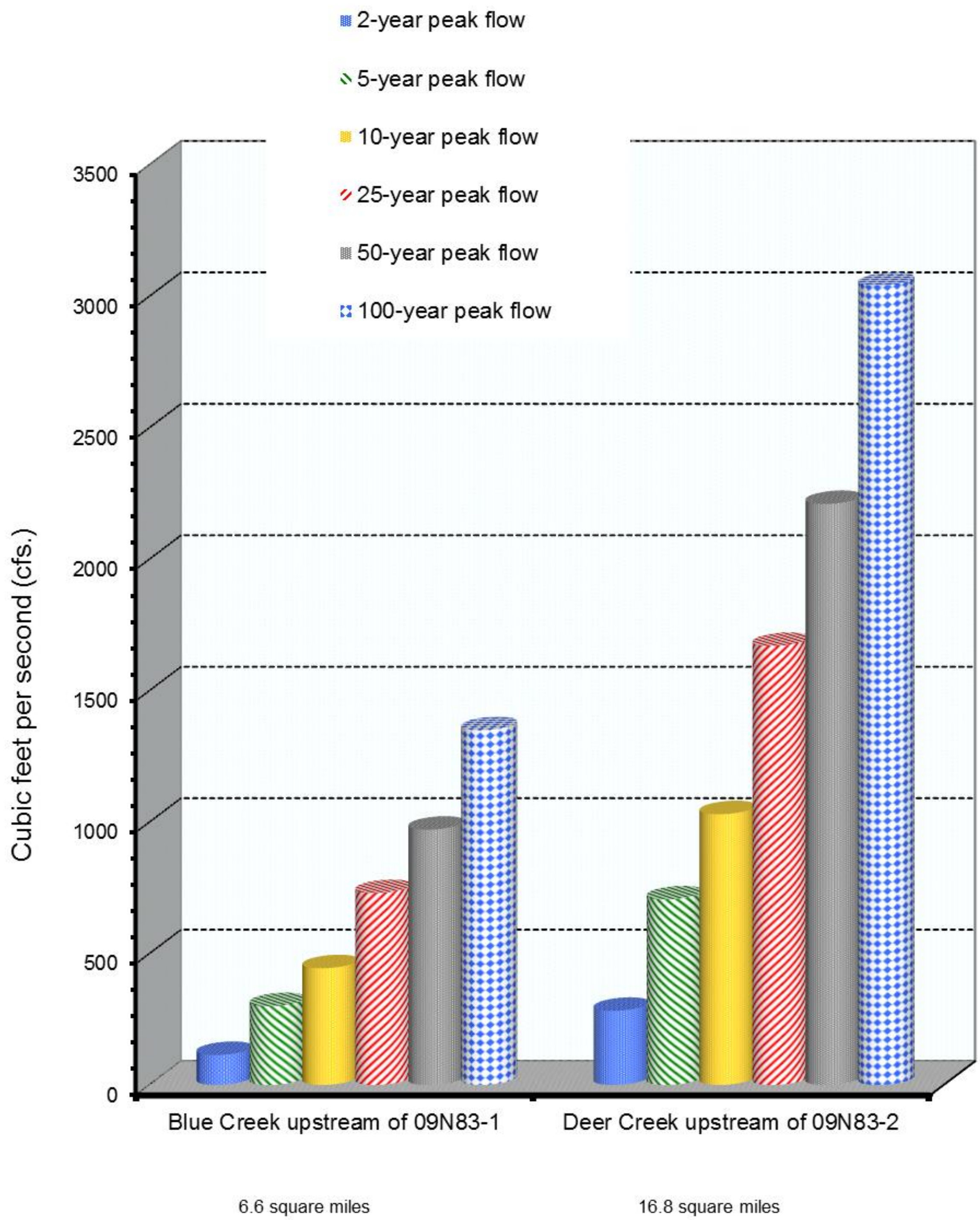
Figures 10 and 11. Several culverts on the Blue Lakes Road (09N01) are small in diameter and partially plugged with sediment. The top photo is described in Point #7 in Table 3, and the bottom photo is described in Point #8 in Table 3. *June, 2015*.

Figure 12. Parking area at the end of the Blue Lakes Road (09N01). *(June 2015).*

The parking area was delineated and covered with gravel as part of one of the 4e conditions for the Mokelumne River Project (FERC No. 137) licensed to PG&E in 2001. No repairs were prescribed for this parking area under Alternatives 1, 3, and 4 for several reasons:

- *The parking area currently shows no signs of accelerated erosion.*
- *Runoff from the slope on the south side of the parking area (top of photo) drains off of the parking area in several directions – there is no evidence of impoundment of surface water on the parking area.*
- *The area of remnant meadow vegetation below the parking area is very small (approximately 0.04 acres), Although this small area of meadow vegetation may be impacted to some degree from restricted movement of subsurface water underneath the parking area, the impacts to the remaining meadow vegetation surrounding the parking area are negligible.*
- *The parking area has negligible effect on the hydrologic connectivity of the entire meadow complex along the last 0.8 miles of road 09N01. This is because the parking area is very small (approximately 145 feet in length and 45 feet in width, which translates to an area of 0.15 acres) and is located at the end of the road.*

Figure 13. Peak streamflows for Blue Creek and Deer Creek.



ENVIRONMENTAL CONSEQUENCES

Analysis Framework

- This Hydrology Report only analyzes the Deer Valley/Blue Lakes Project. Topics that were analyzed in the Travel Management Environmental Impact Statements of 2008 and 2013 for the Eldorado National Forest are not re-analyzed in this Hydrology Report.
- It is assumed that public motorized vehicle use on the Blue Lakes Road (09N01) and the Deer Valley Trail (19E01) would be low under Alternatives 1, 3, and 4. This is based on estimates of past motorized vehicle use of the two routes by the Amador Ranger District, as described in the *Recreation Report.*
- It is assumed that administrative use of the Blue Lakes Road (09N01) and the Deer Valley Trail (19E01) by motorized vehicles under Alternative 2 (No Action) would be much less than under Alternatives 1, 3, and 4.

Direct and Indirect Effects

<u>Alternative 2 (No Action)</u>

The Blue Lakes Road (09N01) west of Twin Lake would not be brought into compliance with Standard & Guideline #100 of the 2004 Sierra Nevada Forest Plan Amendment. This is because the repairs to improve road 09N01, as described in Table 3, would not occur. In addition, it is likely that additional degradation of the meadows that are crossed by or bordered by road 09N01 would occur for the reasons described below.

- Excessive runoff and sediment from road 09N01 would continue to reach several meadows that are crossed or adjacent to the road. Over a period of time, this would likely cause a larger portion of those meadows to become drier and have less meadow vegetation.
- The culverts that are impeding the movement of surface water and ground water through the meadows would not be improved. For example, water would continue to be impounded behind culverts that are currently plugged or partially plugged or too small in diameter – this is water that would flow into the meadow down-gradient of the road.

The degradation of meadows crossed or adjacent to the Blue Lakes Road (09N01) may be slightly less and occur at a slower rate than has occurred in the past. The reasons for this conclusion are described below.

- The absence of public motorized vehicle use of the road would likely result in slightly less sediment eroded from the road and delivered into adjacent meadows. Research studies have generally shown that a reduction in the amount of motorized vehicle use on a native surface road tends to reduce the amount of sediment generated from the road. This topic was analyzed in the *Final Environmental Impact Statement, Public Wheeled Motorized Travel Management EIS, Record of Decision (March 2008), Chapter 3, Section D.*

- The amount of motorized vehicle use of the road in the past has been fairly low.

The amount of sediment from OHV use that is reaching Deer Creek at Meadow 09N83-2 would not be reduced for several reasons:

- Sediment from Deer Valley 4wd Trail (19E01) would continue to erode into Deer Creek where the trail crosses the stream at Meadow 09N83-2. This is because the short segment of the trail adjacent to each side of the stream (i.e. the "approaches") would not be covered with rock or other materials that reduce erosion and the delivery of sediment into the stream.
- Sediment from the 250 ft. long sediment of the Deer Valley 4wd Trail (19E01) that is less than 30 feet from Deer Creek would continue to erode into the stream. This is because the re-routing of this segment of the trail away from the stream, as well as the restoration of the 250 ft. long road segment, would not occur.
- Several locations where the streambanks of Deer Creek (at Meadow 09N83-2) are denuded and eroding as a result of past OHV use would likely continue to erode. This is because the planting of vegetation and/or sod plugs on those streambanks would not occur.

Erosion would not be reduced at several locations on Deer Creek (at Meadow 09N83-2) and Blue Creek (at Meadow 09N83-1) where past OHV use has resulted in the erosion of stream banks. This is because the planting of vegetation and/or sod plugs on those streambanks would not occur.

Alternative 1 (Proposed Action)

The segment of the Blue Lakes Road (09N01) west of Twin Lake would be brought into compliance with Standard & Guideline #100 of the 2004 Sierra Nevada Forest Plan Amendment, and such compliance would occur as soon as the repairs to the road (described in Table 3) are implemented. In the long-term, this would likely improve the condition of the meadows that are crossed or bordered by this road for two reasons:

- Excessive runoff and sediment from the Blue Lakes Road (09N01) that currently reaches several meadows would be greatly reduced. This would prevent additional drying out of the meadows, and promote the growth of vegetation that is typical of wet meadows.
- The culverts that are impeding the movement of surface water and ground water through the meadows would be repaired or replaced. This means that surface water and ground water would be able to move more freely through the meadow than is occurring at the present time, and the portions of the meadows downslope of the road should become wetter.

Repairs to the Blue Lakes Road (09N01) are described at specific sites are described in Table 3.

The amount of sediment from OHV use that is reaching Deer Creek at Meadow 09N83-2 would be reduced for several reasons:

- The short segment of the Deer Valley 4wd Trail (19E01) adjacent to each side of the stream (where the trail crosses the stream) would be covered with rock or other materials. This would reduce the delivery of sediment into the stream from the trail approaches to the stream. It should be noted, however, that fine-grained sediment contributed to the stream from vehicles driving on the bottom of the stream channel (for a distance of approximately 30 to 50 feet at low streamflows) would still occur.
- Sediment from the 250 ft. long sediment of the Deer Valley 4wd Trail (19E01) that is less than 30 feet from Deer Creek would no longer reach the stream. This is because this segment of the trail would be re-routed away from the stream, and restoration of the abandoned road segment would occur.
- Several locations where the streambanks of Deer Creek are eroding as a result of past OHV use would be rehabilitated by planting vegetation and/or sod plugs on those streambanks.
- The crossing of the Deer Creek by the Deer Valley 4wd Trail (19E01) would be delineated with boulders. This should prevent the crossing from becoming wider.

As a result of the above items, the plume of sediment in Deer Creek at Meadow 09N83 that is generated when vehicles cross the stream should be shorter in length and the turbidity values of that segment of the stream should be less elevated. Estimating the distance that the plume of sediment would travel downstream and the numerical turbidity values of the stream would be speculative for the reasons described in the footnotes below. [1,2] A summary of actions under Alternative 1, effects to aquatic features, and applicable BMP's is in Table 3.

Erosion would be reduced at several locations on Deer Creek (at Meadow 09N83-2) and Blue Creek (at Meadow 09N83-1) where past OHV use has resulted in the erosion of stream banks. This is because the planting of vegetation and/or sod plugs on those streambanks would occur.

Ground disturbance would occur in a small portion of a number of meadows and their associated Riparian Conservation Areas (RCAs).[3]

- Less than 10 percent of each meadow and associated RCA crossed or bordered by the Blue Lakes Road (09N01) would be disturbed. This is because the repairs to the road would be confined to the surface of the road and a discrete number of small areas immediately adjacent to the road. The width of the road is approximately 15 feet, and the discrete small areas immediately adjacent to the road generally would extend less than 20 feet from the edge of the road.
- Less than 2.0 percent of Meadow 09N83-2 and its associated RCA would be disturbed. This is because the meadow and its RCA is over 20 acres in size and the proposed activities in these features total less than 0.4 acres.

Table 3. Repairs to the Blue Lakes Road (09N01) that would occur under Alternatives 1, 3, and 4.[1,2,3]

Point	UTM coord.[4]	Existing Condition	Repairs to road 09N01	How repairs meet Standard & Guideline #100
2	0243369 4277694	Runoff and sediment from a 400 ft. long segment of road 09N01 is reaching a narrow meadow on the south side of the road - the primary rill in the road is nearly 400 feet in length and up to 6 inches in depth. The resulting deposition of sediment from the road into the meadow has caused a portion of the meadow to become drier. (Figure 9).	Construction of 2 or 3 rolling dips in the 400 long road segment upslope of the meadow. (Example in Figure 14).	The rolling dips will divert most of the runoff and sediment from the road into the forest before the runoff and sediment reaches the meadow. This will greatly reduce the drying out of the meadow as a result of sediment from the road being delivered into the meadow.
6	0243206 4277637	The culvert underneath the road is approximately 1 ft. in diameter. As a result, the movement of surface water through the meadow is impeded, particularly during higher streamflows. A small amount of runoff and sediment from the road 09N01 is reaching a stream and a meadow adjacent to the stream. This may contribute to a portion of the meadow being less wet. (Figure 8).	Replace the existing culvert with a culvert that will pass flow and debris from the 100-year precipitation event (Example in Figure 15). Raise the height of the road surface for a distance of approximately 150-200 feet.	Most of the surface flow will be able to pass through the culvert. This will allow more surface water to reach the meadow down-gradient of the road. Most of the runoff and sediment from the road will flow away from the stream and adjacent meadow.
7	0243109 4277564	Runoff and sediment from road 09N01 is reaching a meadow. The resulting deposition of sediment has caused a portion of the meadow to become drier. (Figure 10).	Raise the height of the road surface for a distance of approximately 150-200 feet. Replace the existing culvert (if needed) with a culvert that will pass flow from the 100-year precipitation event.	Most of the runoff and sediment from the road will flow away from the stream and adjacent meadow. This will greatly reduce the drying out of the meadow contributed by sediment from the road into the meadow.
8	0242913 4277481	The culvert underneath the road is approximately 1 ft. in diameter and the inlet is almost completely plugged with sediment. As a result, much of the surface water above the road cannot reach the meadow below the road. There is a 2 ft. vertical drop at the outlet of the culvert - this is causing erosion of the stream channel. A small amount of runoff and sediment from road 09N01 is reaching a stream and a meadow adjacent to the stream. The resulting deposition of sediment has caused a portion of the meadow to become drier. (Figure 11).	Replace the existing culvert with a culvert that will pass flow from the 100-year precipitation event. Place riprap at the outlet of the culvert. Raise the height of the road surface for a distance of approximately 100-150 feet.	Most of the surface flow will be able to pass through the culvert. This will allow more surface water to reach the meadow below the road. Most of the runoff and sediment from the road will flow away from the stream and adjacent meadow. This will greatly reduce the drying out of the meadow as a result of sediment from the road into the meadow.

[1] Repairs to the Blue Lakes Road (09N01) at Points 2, 6, 7, and 8 were developed by Tim Merten (Engineer) and Steve Markman (Hydrologist) in order to meet S&G #100 with regard to meadows. Other points (1, 3, 4, 9, etc.) relate to locations where notes were made that do not relate to Standard & Guideline #100 with regard to meadows.
[2] Standard & Guideline #100 states: *"Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity."*
[3] The methodology for evaluating compliance with Standard & Guideline #100 is described in Appendix A.
[4] UTM NAD 83 zone 11.

Figure 14. An example of a rolling dip in a road. Surface water flows down the road from the right to the left, and then flows off of the road at the base of the rolling dip.

Figure 15. An example of a culvert that can pass the flow that results from a 100-year precipitation event.

Alternatives 3 and 4

The effects from Alternatives 3 and 4 are expected to be the same as Alternative 1(Proposed Action). There are two reasons for this conclusion.

- The restoration activities that would occur under Alternative 1 would also occur under Alternatives 3 and 4. These restoration activities are described in Tables 3 and 4 of this document and in the *Environmental Assessment*.
- Public motorized vehicle use of the two routes would be fairly low under Alternatives 1, 3, and 4.

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[1] The distance that the plume of sediment travels downstream and the actual turbidity values of the stream depend on a number of factors, such as: a.) the discharge of the stream, b.) the velocity of the water, c.) the type and number of vehicles crossing the stream at nearly the same time, d.) the composition and integrity of the stream channel bottom at the time when vehicles drive across the stream, and f.) the width of the stream at the time when vehicles cross the stream.

[2] In September 2014, a visible plume of sediment traveled approximately 100 feet downstream of where trail 19E01 (09N83) crosses Deer Creek at Meadow 09N83-2 after the stream was crossed by several jeeps at approximately the same time. The water appeared clear approximately 100 feet downstream of the crossing as well as upstream of the crossing.

[3] The Riparian Conservation Area (RCA) surrounding a meadow is 300 feet.

Table 4. Summary of actions under Alternatives 1, 3, and 4 for meadows of the Deer Valley/Blue Lakes Project.

<table>
<tr><th></th><th>Actions that would occur under Alternatives 1, 3 and 4</th><th>How Standard &Guideline #100 would be met as a result of actions under Alternatives 1, 3, and 4</th><th>Applicable Best Management Practices (BMPs) with regard to Alternatives 1, 3, and 4[1]</th></tr>
<tr><td>Meadows 09N01-ALL</td><td>Repairs to road 09N01 (west of Twin Lake) would occur at four locations – this is described in Table 3.

Seasonal closure of road 09N01 – length of closure varies by alternative.</td><td>• Excessive runoff and sediment from road 09N01 that currently reaches several meadows would be greatly reduced – this is described in Table 3.
• The culverts that are impeding the movement of surface water and ground water through the meadows would be repaired - this is described in Table 3.</td><td><u>BMP 4.7.2 (Trail location and design)</u>
▪ Road 09N01 (west of Twin Lake) crosses or borders a complex of small meadows. A complete re-route of the road west of Twin Lake would also cross a number of meadows, as well as steep outcrops of granitic rocks. Figure 16 shows an aerial photograph of the landscape surrounding road 09N01 west of Twin Lake.

<u>BMP 4.7.3 (Trail watercourse crossings)</u>
▪ Road 09N01 crosses several small stream channels. Improvements to these crossings are described under Column 2 and Table 3.

<u>BMP 4.7.4 (Trail construction & reconstruction)</u>
▪ The segment of road 09N01 west of Twin Lake will be repaired so as to improve the drainage of the road and reduce impacts to meadows that are crossed or bordered by the road. The repairs are described in column 2 and Table 3.

<u>BMP 4.7.5 (Monitoring)</u>
The segment of road 09N01 west of Twin Lake will be monitored as described in the Eldorado National Forest Travel Management SEIS Settlement Agreement Monitoring Plan (2015).</td></tr>
<tr><td>Meadow 09N83-1</td><td colspan="2">Meadow 09N83-2 was rated as meeting S&G #100 in July 2011. The meadow was re-evaluated in August 2014 and other concerns have resulted in the following proposed actions:
• Several locations where the streambanks of Blue Creek are eroding as a result of past OHV use would be rehabilitated by planting vegetation and/or sod plugs on those streambanks.
• Trail 19E01 at Meadow 09N83-1 would be closed seasonally – the length of closure varies by alternative.</td><td><u>BMP 4.7.2 (Trail location and design), BMP 4.7.3 (Trail watercourse crossings), and BMP 4.7.4 (Trail construction & reconstruction.</u>
Trail 19E01 crosses Blue Creek one time. Alternatives 1, 3, and 4 contain actions that would reduce the impacts of this crossing to Deer Creek. These actions are described in Column 2.

<u>BMP 4.7.5 (Monitoring)</u>
Monitoring will occur as described in the Eldorado National Forest Travel Management SEIS Settlement Agreement Monitoring Plan (2015).</td></tr>
</table>

[1] The complete text of all applicable BMPs can be found in the 2011 Water Quality Management Handbook (Region 5, USDA).

Table 4 (continued). Summary of actions under Alternative 1 (Proposed Action) for the meadows of the Deer Valley/Blue Lakes Project.[1]

<table>
<tr><th></th><th>Actions that would occur under Alternatives 1, 3 and 4</th><th>How Standard &Guideline #100 would be met as a result of actions under Alternatives 1, 3, and 4</th><th>Applicable Best Management Practices (BMPs) with regard to Alternatives 1, 3, and 4[1]</th></tr>
<tr><td>Meadow 09N83-2</td><td colspan="2">Meadow 09N83-2 was rated as <u>not</u> meeting S&G #100 in July 2011. The meadow was re-evaluated in August 2014 and found to be in compliance with S&G #100 – this re-evaluation is in Appendix A. However, other concerns that were noted with regard to the Deer Valley 4wd trail in Meadow 09N83-2 (as described in the column “characteristics” of Table 2) have resulted in the follow proposed actions:
The short segment of trail 19E01 adjacent to each side of the stream (where trail crosses the stream) would be covered with rock or other materials.
A 250 ft. long segment off trail 19E01 that is less than 30 feet from Deer Creek would be re-routed away from the stream, and restoration of the abandoned road segment would occur.
Several locations where the streambanks of Deer Creek are eroding as a result of past OHV use would be rehabilitated by planting vegetation and/or sod plugs on those streambanks.
The crossing of the Deer Creek by trail 19E01 would be delineated with boulders.
Trail 19E01 at Meadow 09N83-2 would be closed seasonally - the length of closure varies by alternative.</td><td><u>BMP 4.7.2 (Trail location and design), BMP 4.7.3 (Trail watercourse crossings), and BMP 4.7.4 (Trail construction & reconstruction.</u>
Trail 19E01 crosses Deer Creek one time. Alternative 1 (Proposed Action) contains actions that would reduce the impacts of this crossing to Deer Creek. These actions are described in Column 2, and an analysis of these actions has been previously described.

<u>BMP 4.7.5 (Monitoring)</u>
Monitoring will occur as described in the Eldorado National Forest Travel Management SEIS Settlement Agreement Monitoring Plan (2015).</td></tr>
</table>

[1] The complete text of all applicable BMPs can be found in the Water Quality Management Handbook (USDA 2011).

CUMULATIVE EFFECTS

The analysis of cumulative watershed effects (CWE) considers all past, present, and likely future land disturbances in a given drainage area. In the Eldorado National Forest (ENF), the major potential cumulative watershed effect is the degradation of habitat for aquatic and riparian species. This can result when land disturbances - roads, timber harvest, wildfire, etc. - increase the amount of sediment delivered to aquatic features. In the ENF, the risk of the occurrence of CWE for each watershed is assigned to one of the following four categories: *low*, *moderate*, *high*, or *very high*. The assignment of the risk of CWE is based on a quantitative evaluation of the land disturbances in the watershed using the method of equivalent roaded acres (ERA). The ERA method is described in more detail in Table 6.

The three watersheds that contain the Deer Valley/Blue Lakes Project are currently at a *low* risk of CWE. This is because land disturbances in these watersheds are mostly confined to a relatively small number of roads, trails, campgrounds, dams, and associated parking areas. An aerial view of portions of these watersheds is in Figures 16 and 17.

None of the alternatives change the risk of cumulative watershed effects (CWE) in the three HUC 7 watersheds that contain the Deer Valley/Blue Lakes Project (Table 5 and Figure 18). This is because the amount of ground disturbance that would result from the Deer Valley/Blue Lakes Project – less 0.01 percent equivalent roaded acres - is negligible and far less than the 0.1 percent resolution of the ERA model at the watershed scale.

Table 5. Risk of cumulative watershed effects (CWE) in the three watersheds that contain the Deer Valley/Blue Lakes Project.[1,2,3,4]

				ERA in 2014 - expressed as a percent of the TOC	
Watershed	**ENF Number**	**Total watershed Acres**	**Risk of CWE in 2016 - all alternatives**	**% ERA in 2016**	**% ERA expressed as a percent of the TOC in 2016**
Meadow Creek	1521	4,981	Low	0.6	6.3
Blue Lakes	1411	5,277	Low	2.3	22.5
Lower Deer Creek	1711	2,955	Low	0.2	1.9

[1] CWE = Cumulative Watershed Effects. ERA = Equivalent Roaded Acres. ENF = Eldorado National Forest. TOC = Threshold of Concern..
[2] Risk of CWE, expressed as a percent of the TOC: 0 - 49% = Low risk; 50 - 80% = Moderate risk; 81 - 100% = High risk; greater than 100% (greater than the TOC) = Very high risk.
[3] No reasonably foreseeable land disturbances have been identified in these watersheds. In order for a land disturbance to be considered reasonably foreseeable, the number of acres, type of ground disturbance, and year(s) of disturbance must be identified.
[4] Assumes that Alternative 1, 3, or 4 would be implemented in 2016.

Figure 16. Aerial view of the landscape surrounding the Blue Lakes Road (09N01) to the west of Twin Lake.

The road is shown as a white line. The western part of Twin Lake is on the right edge of the photo, and the eastern part of Meadow Lake is on the left edge of the photo. The white areas are outcrops of granitic rocks, and most of the dark green areas without trees are meadows or areas of alder and other vegetation.

Figure 17. Aerial view of the landscape to the southeast of Blue Lake and Twin Lake (upper left of photo), which includes Clover Valley and Deer Valley.

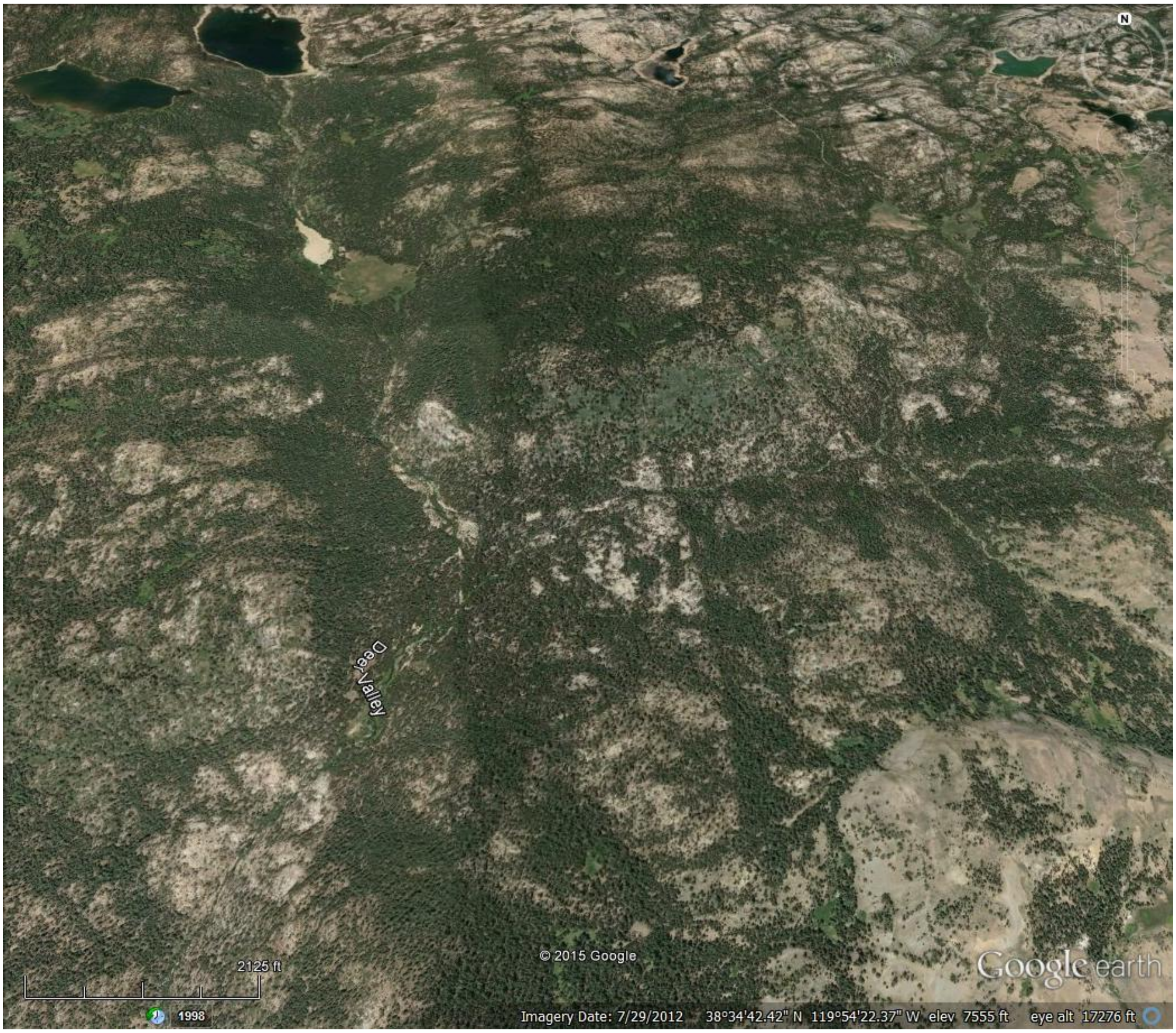
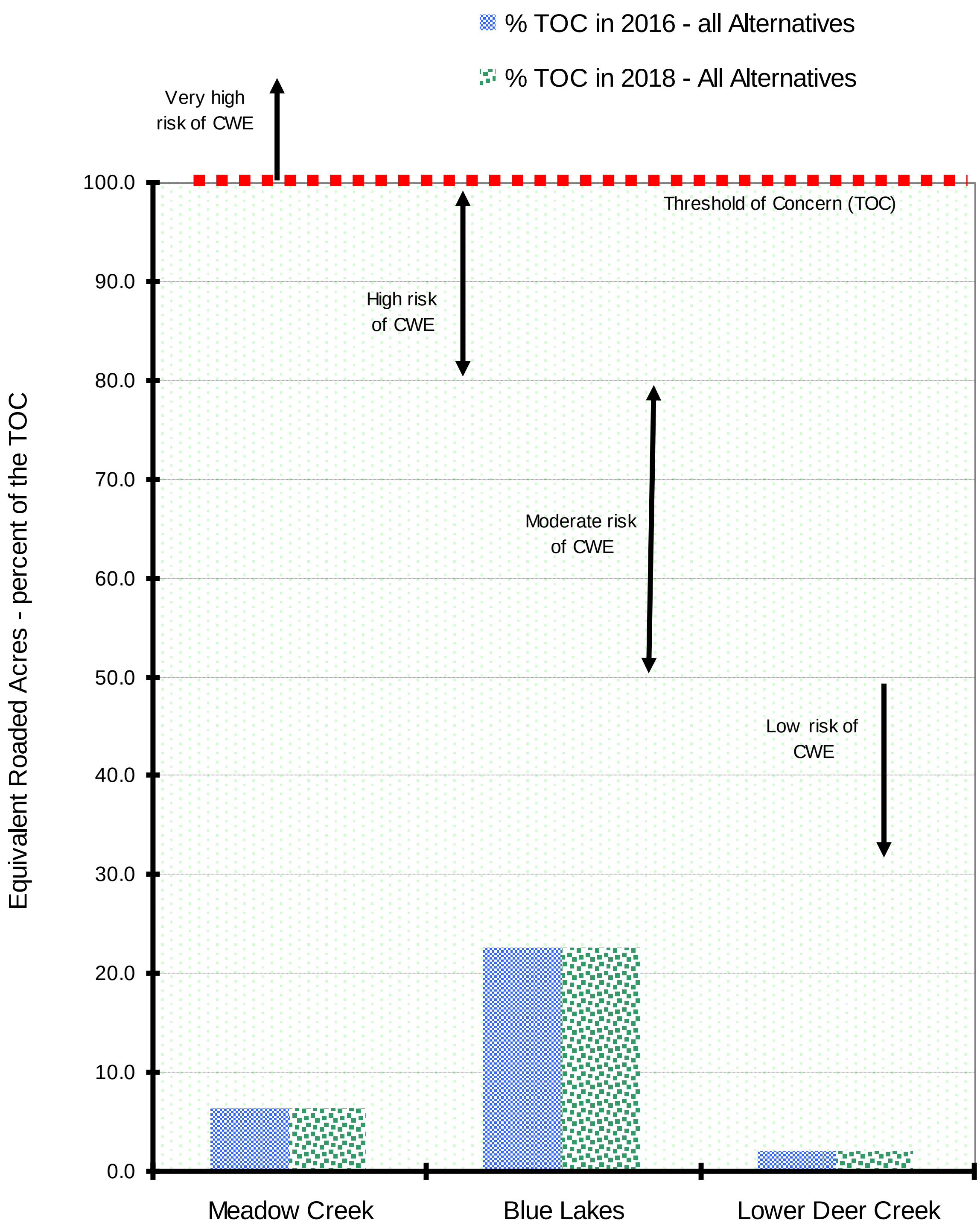


Figure 18. Risk of Cumulative Watershed Effects (CWE) in 2016 - expressed in terms of Equivalent Roaded Acres (ERA) as a percent of the Threshold of Concern (TOC) - for the watersheds that contain the Deer Valley/Blue Lakes Project.[1]



[1] Assumes that Alternatives 1, 3 and 4 are implemented in 2016.

Table 6. Description of the Method of Equivalent Roaded Acres (ERA) for assessing the risk of Cumulative Watershed Effects (CWE).

Summary
The risk of cumulative watershed effects (CWE) is assessed using the Equivalent Roaded Acre (ERA) method developed by R5 USFS. The process was further refined and adapted for the Eldorado National Forest (1993). In this method, an index is calculated for an entire watershed that expresses most land use in terms of the percent of the watershed covered by roads. Based on the ERA and a threshold of concern (TOC), a given watershed is assigned a relative risk – *low, moderate, high,* or *very high* - of CWE. The primary cumulative impact of concern is an increase in sediment delivery to streams and degradation of aquatic habitat.
Important aspects of the ERA method
▪ Roads, which are considered to have the greatest potential to increase runoff and sediment to streams, are given a value of 1.0. The number of acres of roads in a watershed is divided by the size of the entire watershed (in acres). This gives the percent of the watershed covered by roads. ▪ For each land disturbance activity other than roads, the number of acres is multiplied by a number less than 1.0. The result (for each land disturbance activity) is then divided by the number of acres of the entire watershed. This gives the percent of the "equivalent roaded acres" in the watershed for each type of land disturbance. ▪ The values for equivalent roaded acres for all of the land disturbance activities are added together. The final number represents the percent of the watershed that is covered by the 'equivalent' of roads. ▪ The threshold of concern (TOC) is usually between 10 and 18 percent. That is, when 10 to 18 percent of a watershed is covered by the equivalent of roads, there is a "*very high* risk" that increased peak flows of streams and sediment delivery to streams will occur. This does not mean these effects will occur precisely when the ERA reaches the TOC, or that an increase in peak flows and sediment delivery to streams will automatically result in a degradation of fish habitat or diminish the experience of recreationists. It is merely a warning that cumulative effects might occur.
Assumptions and limitations of the ERA method
▪ The method is intended for watersheds between 3,000 and 10,000 acres in size, although the method is commonly used for watersheds slightly outside of this range. ▪ ERA values, as well as the TOC, are only indicators of the risk of cumulative impacts occurring. They cannot be used to determine the percent or numerical amount of increase of sediment delivery to streams, stream channel eroded, fish habitat degraded or lost, or any other change in watershed condition. Such quantitative assessments require additional analysis. ▪ The location of land disturbance activities within a watershed is not considered. For example, roads near streams are treated exactly the same as roads that are far from streams. In reality, roads located within or next to riparian areas tend to contribute more sediment to streams than roads in upland areas. ▪ Recovery of the watershed from land disturbing activities occurs with time. For timber harvest activities, hydrologic recovery is assumed to be thirty years (i.e. ERA contribution is zero thirty years after timber harvest.) ▪ The ERA calculations do not take into account site specific BMPs that will be applied. ▪ ERA values start one year after a land use is implemented.
Risk categories[1]
▪ Low risk of CWE - ERA is less than 50% of TOC ▪ Moderate risk of CWE - ERA is between 50% and 80% of TOC ▪ High risk of CWE - ERA is between 80% and 100% of TOC ▪ Very high risk of CWE - ERA is greater than TOC

[1]Guidance to reducing the risk of CWE can be found in Section 2509.22, Chapter 20 of the Soil and Water Conservation Handbook (USDA 1990).

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APPENDIX A. HYDROLOGIC INFORMATION

Table A-1. Description of the field surveys of meadows in the Eldorado National Forest (ENF) in 2011 and 2012.[1]

Purpose of field surveys	To determine if specific road or trail segments are causing adjacent meadows to not meet Standard and Guideline #100 of the Sierra Nevada Forest Plan Amendment of 2004.
Standard and Guideline #100	*"Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity."*
Definition of a meadow[2]	*"A meadow is defined as a grassy opening, 0.1 acres or larger, dominated by perennial sedges, rushes, and grasses (wet meadow) or perennial grasses and forbs (dry meadow)."*
Characteristics of a meadow[3]	✓ *"A meadow is an ecosystem type composed of one or more plant communities* dominated *by herbaceous species.* ✓ *It supports plants that use surface water and/or shallow groundwater (generally at depths of less than one meter).* ✓ *Woody vegetation, like trees or shrubs, may occur and be dense but are not dominant."*
Definition of hydrologic connectivity	The hydrologic connectivity of a meadow exists when the surface and subsurface flow of water through the meadow has not been visibly altered by the road or trail segment.
Methodology[4]	<u>Description.</u> A field survey form for meadows was developed specifically to evaluate compliance with Standard & Guideline #100. The questions on page 2 of the survey form are specific to *visible or noticeable evidence of alteration of the surface and subsurface flow of water through the meadow*. The questions are qualitative, require hydrologic knowledge and field experience to answer, and are based on features that are visible at the ground surface, but reflect surface and subsurface water flow characteristics as described in the criteria below.[4] <u>Assumptions</u> • The mere presence of a road or trail through or adjacent to a meadow (on-the-ground) does <u>not</u> determine if Standard and Guideline #100 is being met. This is because it is possible for a road or trail to occur within or adjacent to a meadow without a visible alteration of surface or subsurface flow of water into or through the meadow. • A disruption of surface and/or subsurface flow in the meadow by a road or trail would result in evidence that can be seen at the surface, such as changes in vegetation, presence of deposited sediment, gullies, incised stream channels, etc. <u>Criteria for rating Standard &Guideline #100</u> Roads and trails were rated as <u>not</u> meeting Standard & Guideline #100 if field evidence was visible that shows one or more of the following: • The road or trail intercepts and diverts surface and/or subsurface water from the meadow and routes the water away from the meadow such that the meadow has decreased in size and/or wetness. • Runoff from the road or trail has eroded sediment into the meadow such that the size and/or wetness of the meadow has been reduced. • Runoff from the road or trail has caused a stream channel to downcut such that the water table next to the stream has dropped and the size and/or the wetness of the meadow has decreased.

[1] Most of the field surveys were completed in 2011. Field surveys were completed by Steve Markman, Hydrologist, and Ryan Lockwood, Hydrologic Technician.

[2] As quoted from the *Land Resource Management Plan for the Eldorado National Forest* of 1989.

[3] As quoted from the *Meadow Hydrogeomorphic Types for the Sierra Nevada and Southern Cascade Ranges in California* (USDA 2011).

[4] The methodology was created by Steve Markman, Hydrologist, Eldorado National Forest. The detailed inventory method described in *Groundwater-Dependent Ecosystems (General Technical Report WO-86a, March 2012)* does not include a survey form that is specific to evaluating Standard and Guideline #100 of the 2004 Sierra Nevada Forest Plan Amendment.

September 18, 2014.

TO: Rick Hopson, District Ranger, Amador Ranger District, Eldorado National Forest.

FROM: Steve Markman, South Zone Hydrologist, Eldorado National Forest.

SUBJECT: Meadow 09N83-2 (19E01-2) and compliance with Standard & Guideline #100.

Location

Meadow 09N83-2 (19E01-2) is located approximately 2.9 miles south of Lower Blue Lake, Amador Ranger District, Eldorado National Forest.

Proximity of route 19E01 (09N83) to meadow 09N83-2 (19E01-2)

Route 19E01 (09N83) borders a short segment of Deer Creek before crossing the stream, and this segment is less than 30 feet from the stream (Figure 1). Deer Creek flows through the middle of meadow 09N83-2 (19E01-2).

Background

Meadow 09N83-2 (19E01-2) was rated as not being in compliance with Standard and Guideline #100 of the Sierra Nevada Forest Plan Amendment (2004) on July 28, 2011. The primary reason for this rating, as described in the original field survey form, was: *"Downcutting, widening and sedimentation from the road are inhibiting hydrologic conductivity and dropping the water table to allow for conifer encroachment."*

Standard & Guideline #100 states: *Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying roads and trails that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.*
The original field survey form for meadow 09N83-2 (19E01-2) is the Project Record.

Review of meadow 09N83-2 (19E01-2)

It is my opinion that meadow 09N83-2 (19E01-2) is in compliance with Standard & Guideline (S&G) #100. The evidence for this conclusion - based on a field review of the site on August 27, 2014 - includes the following:

- The channel of Deer Creek is actively re-adjusting itself as the stream flows through extensive alluvial deposits in meadow 09N83-2 (19E01-2). This means that the erosion of the stream channel, particularly at meander bends such as where route 19E01 (09N83) borders the stream (Figure 1), is mostly a natural occurrence and has very little to do with the presence of route 19E01 (09N83). In addition, the erosion of the stream channel at two former and one current route crossing of the stream is extremely minor when compared to the on-going erosion of the entire stream channel through the meadow.

- Route 19E01 (09N83) is not entrenched into the meadow, there was no water ponded in the road or flowing down the route, and the route occurs in less than 15 percent of the length of the meadow. This means that route 19E01 (09N93) is not intercepting and diverting surface and/or subsurface water from the meadow and routing the water away from the meadow such that the meadow has decreased in size and/or wetness. In addition, the amount of runoff from route 19E01 (09N83) into Deer Creek is negligible when compared to the flow of the stream.
- There are only a few small rills (less than 6 inches in depth) and no gullies that extend from route 19E01 (09N83) into the meadow. This suggests that runoff from route 19E01 (09N83) has not eroded sediment into the meadow such that the size and/or wetness of the meadow has been reduced.

Figure 1. A segment of route 19E01 (09N83) borders Deer Creek and meadow 09N93-2 (19E01-2). The erosion of the stream channel at this location is at the outside of a meander bend.

Steve G. Markman

Background Information concerning Cumulative Watershed Effects.

Definition of CWE	The analysis of cumulative watershed effects (CWE) considers the impacts of all past, present, and foreseeable land disturbances. The land disturbances selected for the analysis of CWE include those that have the potential to result in erosion and an increase in sediment delivery to aquatic features. These land disturbances include, but are not limited to: past timber harvest (both in the National Forest and on private land), roads, fires, man-made impervious areas associated with buildings and other facilities, powerline corridors, and campgrounds. An increase in the amount of sediment delivered to aquatic features can result in a number of negative effects.[1]
Geographic scope of CWE	The 7th field watersheds, which are generally 3,000 to 10,000 in size, that include the proposed land disturbance or changes in land disturbance. Sub-watersheds less than 3,000 acres in size may be delineated for analysis if land disturbances are concentrated in those areas.
Methods and limitations of assessing CWE	There are a number of methods currently used to assess CWE where the primary direct impact of concern is an increase in sediment delivery to streams and other aquatic features. None of these methods can quantitatively predict the amount of sediment delivered to streams, the distance downstream that the sediment load will travel, or point in time and the duration when an increase in sediment delivery to aquatic features will occur. The reasons for this include the large variability in the magnitude of direct effects from a given land disturbance, inability to predict secondary or indirect effects, lack of data on recovery rates for land disturbances, difficulty of validating predictive models on-the-ground, and the uncertainty of future events such as the size and timing of large storms. As a result, an assessment of CWE is frequently reported as an indicator of the overall *risk* of cumulative effects occurring in a watershed (Reid 1993; MacDonald 2000).
Magnitude or severity of CWE	The magnitude or severity of CWE following land disturbance depends largely on an event that cannot be prevented and the exact timing of which cannot be accurately predicted. It is whether a "large storm event" occurs within several years after land disturbances when the ground surface is vulnerable to erosion. If a large storm event does not occur within several after the land disturbance, the CWE to aquatic features will be minor, negligible, or absent. As a result of the importance of large storm events in determining actual erosion, sediment delivery to streams, turbidity and suspended sediment levels of streams, the land disturbances themselves in the watersheds play only a partial role in the severity of impacts to aquatic resources.
Method of CWE used in the Eldorado National Forest	The method selected for this CWE analysis is the method of Equivalent Roaded Acres (ERA). This method was developed by Region 5 of the U.S. Forest Service and adapted by the Eldorado National Forest (ENF). The method was specifically developed to assess the *risk* of CWE in forested watersheds where timber harvest and roads are major land disturbances. The ERA method has been used in the ENF for over 15 years, and nearly all of the 155 watersheds in the ENF have been evaluated with this method. This allows all of the watersheds in the ENF to be compared relative to each other in terms of the risk of CWE.
Description of the method of Equivalent Roaded Acres (ERA)	An index is calculated for an entire watershed that expresses most land uses in terms of the percent of the watershed covered by roads. Based on the percent ERA and a threshold of concern (TOC), a given watershed is assigned a relative risk – *low*, *moderate*, *high*, or *very high* - of cumulative impacts. A *very high risk* is merely a warning that cumulative impacts – such as an increase in sediment delivery to streams – might occur. The ERA method has the same limitations as previously described for all commonly used CWE methods where an increase in sediment delivery to streams is the primary concern.

[1] One well-documented cumulative effect is the reduction in the amount and quality of spawning habitat for resident fish as a result of fine-grained sediment deposited in the stream channel.

Potential Cumulative Watershed Effects.

Primary Effects	
1. Increase in the peak flows of streams.	**2. Increase in the amount of sediment delivered to streams.**
During and immediately after large precipitation events and periods of rapid snowmelt.	
1. *Erosion of stream channels.* Amount of erosion depends on: a) size and duration of peak flow, b) inherent stability of channel. (Alluvial channels erode more than those controlled by bedrock.) 2. *Increase in the turbidity of streams*. This can affect the health of fish, affecting movement and feeding. 3. *Alteration of fish habitat.* ▪ Removal of cover (large woody debris, overhanging banks, rocks). ▪ Covering of spawning areas with fine-grained material. ▪ Reduction in stream channel diversity. Examples: pools filled in with alluvial material, removal of large woody debris.	1. *Increase in the turbidity of streams.* This can affect the health of fish, possibly resulting in death. 2. *Alteration of fish habitat.* ▪ Pools fill in with alluvial material. ▪ Spawning areas are covered with fine-grained sediment.
1. *Fisheries*. Impacts to fish are described under "secondary impacts." 2. *Recreation.* ▪ Adverse impacts to fish diminish fishing opportunities. ▪ Eroded stream channels are less aesthetically pleasing to people that come to streams to recreate.	1. *Fisheries*. Impacts to fish are described under "secondary impacts." 2. *Recreation*. Streams with turbid water are less aesthetically pleasing to most people than streams with clear water.